Investigation of Marketing Strategies and Production Techniques for Small Farms

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Background:

Producing and marketing specialty crops may offer small-acreage growers an opportunity to develop potentially profitable niche markets. One such crop in Pennsylvania is edamame (*Glycine max* [L.] Merrill), also known as vegetable soybean. Edamame is the same species as agronomic soybean, but cultivars are selected for their sweet, mild flavor and nutty texture (Yinbo et al., 1997). Edamame beans are harvested for human consumption at an immature green stage and are rich in vitamin C, vitamin E, dietary fiber (Johnson, 2000), vitamin A, calcium, and protein (Miles et al., 2000). Edamame is also one of the few natural sources of a group of phytoestrogens known as isoflavones (Rao et al., 2002). Health benefits from eating foods like edamame can include strong bones and teeth, lower cholesterol levels, prevention of cardiovascular disease, and reduction in mammary and prostrate cancers (Rao et al., 2002).

Edamame is a crop that may provide small-acreage growers with a means to diversify production and marketing efforts (Miles and Alleman, 2001). According to the USDA, small-acreage growers are defined as those producing on one to 99 acres. As consumer interest in edamame increases, it is critical that production and marketing efforts are investigated so that appropriate production methods are developed and potential profitability and consumer demand are documented. Prospective markets include the restaurant industry, supermarket stores, value-added processors, and other direct marketing ventures such as farmers' markets, roadside stands, and Community Supported Agriculture enterprises.

Edamame was selected from a list of alternative crops compiled by the Alternative Farming Systems Information Center (Gold and Thompson, 2001). It was chosen based on its suitability for production in Pennsylvania, its high phytonutrient content, and potential profitability to growers. Grain soybeans and other beans are currently grown in Pennsylvania

(National Agricultural Statistical Service). Similar production requirements are needed in edamame culture and the harvesting equipment used for green beans can be used to harvest edamame or it can be hand harvested.

Studies addressing edamame production and marketing techniques in Pennsylvania were proposed to offer growers the opportunity to enter this potentially lucrative market.

Project Outline and Approach to Investigating the Issue:

The goals of this research were to develop fundamental production techniques for small-acreage farmers and provide basic marketing information on perceptions, preferences, and demand for edamame produced by Pennsylvania growers.

Edamame Production as Influenced by Seedling Emergence and Plant Population

To determine suitability for growing in central Pennsylvania, the effect of seedling emergence on edamame production was evaluated. Eight edamame cultivars were field trialed in 2002, 2003 and 2004. Data collection included plant populations (% stand), marketable and unmarketable yields, and edamame pod and bean quality indicators. Plant populations varied by year and cultivar and were generally below 80%. Temperature effects on seedling emergence were then evaluated for four edamame cultivars by using growth chambers programmed with varying day/night temperature regimes. Plant populations varied by cultivar and again were generally below 80% with two exceptions. When grown in a 21.1/15.6ºC day/night temperature regime, 'Butterbeans' and 'Early Hakucho' exceeded 80% plant populations. In the field trial, plant populations affected marketable yields. Pod and bean quality were dependent on cultivar. Results indicated that several edamame cultivars appear promising for growing in Pennsylvania

based on pod and bean quality. However, the issue of poor seedling emergence presents a major constraint to commercial production and needs to be studied further.

Accessing and Understanding Consumer Awareness of and Potential Demand for Edamame

To determine perceptions, preferences and demand for edamame produced by Pennsylvania growers, a number of consumer research studies were conducted between 2002 and 2005. Two separate consumer-marketing studies were conducted between 30 Oct. and 2 Dec. 2002 to determine consumer awareness and potential demand for edamame. The first study consisted of a sensory evaluation that included 113 participants who tasted and rated three edamame cultivars based on firmness and overall appeal and then ranked the beans in order of preference at The Pennsylvania State University, University Park Campus. In order to better estimate demand, the participants answered questions regarding their likelihood to purchase edamame after the sensory evaluation. The second study, a telephone survey, was administered by a market research firm to determine consumer awareness of edamame as well as their produce purchasing habits. Responses were collected from 401 consumers within the Metro-Philadelphia area. Consumer reaction to the sensory evaluation was positive, and after reading about the health benefits, a majority of consumers (92%) indicated they would likely purchase edamame and serve it in a meal, whereas 89% gave this response after only sampling the edamame beans. When responses were compared among cultivars, overall liking for 'Green Legend' (6.29; 1=extremely dislike; 9=like extremely) was significantly lower than for 'Kenko' (6.84); however, neither cultivar was significantly different from 'Early Hakucho' (6.62). Participants also rated 'Kenko' as having a firmness that was 'just about right'. Verbal comments from participants leaving the evaluation site included interest in purchasing edamame and inquiries as

to where it could be purchased in the vicinity of the university. Telephone survey participants also expressed a willingness to purchase edamame and serve it in a meal after hearing about the potential health benefits (66%).

Based on consumer responses to selected telephone survey questions, three distinct marketing segments were created. "Potential Purchasers" (58% of participants), consisted of consumers who were more likely to consider the importance of the nutritional content of vegetables they purchased (73%), included the greatest percent of consumers who had purchased soy or soy-based products (70%), and were "very likely" (51%) and "somewhat likely" (46%) to eat edamame after learning about the health benefits. The second largest segment of participants characterized as "Unlikely Edamame Eaters" (22% of participants) consisted of individuals who were "very likely" (20%) and "somewhat likely" (43%) to purchase vegetables they had never eaten before if evidence suggested that it might decrease the risk of cancer and/or other diseases. However, within this group, none of the participants were either "very likely" or "somewhat likely" to eat edamame after being told about the health benefits. The last group characterized as "Requires Convincing" (20% of participants), consisted of individuals who were the least likely to base produce-purchasing decisions on the nutritional content of vegetables. After learning about health benefits specific to edamame, 8% of these participants were "very likely" and 48% were "somewhat likely" to eat edamame. Hence, it was determined that separate marketing strategies may need to be developed to target these distinct segments based on interest in eating edamame, importance of nutritional information, and current vegetable purchasing habits.

Direct Marketing Edamame to Professional Chefs

In the fall of 2003, a consumer-research study was conducted to determine professional chefs' preferences for the same edamame cultivars used in the previously mentioned sensory evaluation, their estimated demand for edamame, and their interest in acquiring edamame from local Pennsylvania growers. Twenty chefs in the Metro-Philadelphia area were provided with shelled (beans removed from the pod) and unshelled edamame of three cultivars, 'Early Hakucho,' 'Green Legend,' and 'Kenko,' and asked to create a recipe using edamame as an ingredient. Chefs were also asked to rate the edamame cultivars based on overall appeal and firmness and complete a follow-up survey on their preferences for the edamame provided, prior use and interest in locally grown edamame. Chefs indicated that all cultivars were acceptable. The majority of chefs also noted that they were "very likely" to use edamame as an ingredient in a recipe again and 70% noted that they were interested in obtaining contact information for small-acreage growers in Pennsylvania who produce edamame. Results indicate that there is likely a demand for edamame amongst chefs in the Metro-Philadelphia area.

Consumer Interest in Fresh, Inshell Edamame and Acceptance of Edamame-based Patties

In 2004 and 2005, two separate studies were conducted to determine consumer interest in fresh, inshell edamame and acceptance of two edamame-based patties. An in-store consumer research study was conducted in metro-Philadelphia to determine consumer demand for and interest in fresh, inshell edamame. Each Wednesday from 1 Sept. to 6 Oct. 2004, 30 12-ounce plastic clamshells of edamame were placed in the produce department of four supermarkets. Consumers who purchased the clamshell containers were asked to return a two-page survey in an addressed, postage-paid reply envelope that was attached to the bottom of the container. Of the

480 clamshells that were delivered to the four selected supermarkets, 312 (65.0%) were purchased and 33 (10.6%) of the surveys were returned. All respondents indicated that they had heard of or were familiar with edamame prior to purchasing the container and 78.8% had previously purchased edamame from supermarkets, natural food stores, farmers markets, or restaurants. In addition, a friend's recommendation, price, and sample of the product at the supermarket were rated highest among factors likely to affect respondent's purchasing decisions regarding new produce items. Based on the total number of packages sold and conversations with produce department managers, there appears to be a demand for fresh, inshell edamame among supermarket consumers in metro-Philadelphia.

A second study involving a consumer sensory evaluation was conducted 9-10 Feb. 2005 at the Department of Food Science Sensory Evaluation Laboratory, The Pennsylvania State University, University Park campus, to determine consumer acceptance of two edamame-based patties. The two patties were primarily composed of edamame, mushrooms, and onion; however, they differed based on the type of mushroom (either button or Portobello), seasonings used, and the addition of walnuts to one of the recipes. A total of 209 adults were involved with 106 participants sampling the edamame, button mushroom, and walnut patties on the first day and 103 sampling the edamame and Portobello patties on the second day. Participants were asked to rate the patty they sampled on overall appeal, appearance, and flavor on a scale of 1 to 9 (1 being dislike extremely and 9 being like extremely). Overall mean liking for the two patties was 6.38 and 6.58 and mean liking for flavor was 6.44 and 6.83, on day one and day two, respectively. Based on the sample evaluated, 43.4% and 35.9% of participants, each day, indicated that they "probably would buy" or "definitely would buy" this item from a supermarket. Results suggest that consumers found the two edamame-based patties acceptable

indicating their potential for commercial production. Across the two studies, there appears to be consumer interest in purchasing either fresh, inshell edamame or edamame-based patties from a supermarket.

Research Results:

Edamame Production as Influenced by Seedling Emergence and Plant Population and Accessing and Understanding Consumer Awareness of and Potential Demand for Edamame

Project results regarding edamame production are presented in an article published in the July-Sept. 2005 issue of HortTechnology, see attached, while results from the studies addressing consumer awareness of and potential demand for edamame are presented in an article in the August 2005 issue of HortScience, see attached.

Direct Marketing Edamame to Professional Chefs (As presented in Montri et al., in manuscript)

Eighteen chefs completed the study. Sixteen were male, two were female and experience as a chef ranged from three to 30 years. Types of restaurant establishments included: contemporary American, casual upscale vegetarian, Asian-fusion, Japanese, eclectic and international. The number of meals served per week at the restaurants ranged from 12 to 2,800 with three to 500 patrons served each evening. Prices of entrees ranged from $7.50 to $65.00 per dinner.

Chefs completed a sensory evaluation rating each edamame cultivar independently on overall appeal. Responses were combined to create three categories: like, neutral and dislike. Fourteen chefs liked ‘Kenko’ while 12 chefs liked ‘Early Hakucho’ and 11 liked ‘Green Legend’ (Table 1).

Table 1. Chef Ratings for Edamame Sample Overall by Cultivar

Rating for Sample Overall	Number of Chef Responses		
	'Early Hakucho'	'Green Legend'	'Kenko'
Like[1]	12	11	14
Neutral	3	3	1
Dislike[2]	3	4	3

[1] Combined responses: Like extremely, like very much, like moderately and like slightly
[2] Combined responses: Dislike extremely, dislike very much, dislike moderately and dislike slightly

Ten chefs had previous experience using edamame either as an appetizer or in dishes such as Lobster Risotto with Edamame, Edamame Pancakes or Edamame Nori Salad. Chefs had obtained edamame from a variety of sources and had purchased it as shelled or inshell, depending on use. Three of the chefs had purchased products with edamame used as an ingredient.

These 10 chefs were asked to compare the quality of the edamame supplied for this study with the quality of the edamame obtained from other sources. Five chefs noted that the edamame supplied was superior to edamame obtained from other sources, four responded that the edamame was the same quality while one chef noted that the edamame was inferior.

The follow-up survey also addressed preference for cultivar and potential differences in demand for shelled and inshell edamame. After tasting all three cultivars, chefs ranked the cultivars by preference. 'Green Legend' was ranked as most preferred by eight of the chefs with 'Early Hakucho' and 'Kenko' ranked as most preferred by five and four chefs, respectively (Table 2). When chefs indicated the cultivar they preferred least, responses showed little difference between cultivars with each receiving five to six responses. One chef indicated that

preference was dependent on the recipe used, so he was unable to select a cultivar he preferred most or least.

Table 2. Chef Preferences for Edamame Cultivars Based on Taste

Most Preferred		Least Preferred	
Cultivar	Number of Responses	Cultivar	Number of Responses
'Early Hakucho'	5	'Early Hakucho'	6
'Green Legend'	8	'Green Legend'	5
'Kenko'	4	'Kenko'	6

Eleven of the chefs preferred shelled edamame (Table 3). When asked if they had any difficulty removing the beans from the unshelled edamame pods, two chefs answered affirmatively stating that shelling was "too time consuming" and one chef noted that the "pods did not open correctly so the beans would not slip out."

Table 3. Chef Preferences for Shelled and Inshell Edamame

Type of Edamame Preferred	Number of Chef Responses
Shelled	11
Inshell	2
No Preference	5

Chefs used a scale of 1-7 (1 being very unlikely, 4 being neutral and 7 being very likely) to rate how likely they would be to use edamame as an ingredient in a recipe again. All chefs responded with a rating of four (neutral) or higher, with 10 of the chefs indicating that they were "very likely" to use edamame again. When asked if they had an interest in obtaining contact

information for small-acreage growers in Pennsylvania who produce edamame, 14 chefs gave a positive response. Prices chefs were willing to pay for edamame ranged from $0.50-$9.00 per pound for shelled edamame and from $0.25-$7.00 per pound for inshell edamame.

Chefs created original recipes using edamame as an ingredient. Examples of recipes include: Edamame Cakes with Sweet Chili Vinaigrette, Linguini with Zucchini and Fresh Edamame, Moroccan Edamame Soup, Sesame Crusted Ahi Tuna with a Saffron-Ginger Buerre Blanc and a 'Green Legend'-Shiitake Saute, and Edamame Bean and Radish Salad.

Consumer Interest in Fresh, Inshell Edamame (As presented in Montri et al., in manuscript)

Of the 480 clamshells of edamame that were delivered, 65.0% were purchased with the total number of clamshells purchased weekly at all four stores ranging from 64 to 88 (53.3% to 73.3%) and the number of clamshells purchased at individual stores throughout the four week period ranging from 47 to 102 (39.2% to 85.0%). Produce department managers commented that they were happy with the number of packages sold and thought the numbers would increase, as a result of consumer recognition, if the edamame was in the store longer than a four-week period.

Thirty-three surveys were returned resulting in a 10.6% response rate, which is similar to the 11% typical response rate for a direct-mail survey (Reed, 1999). The number of survey responses was similar over time and between stores. Data were pooled to create a larger data set for interpreting the respondents' survey answers (Kelley et al., 2002).

All respondents indicated that they had heard of or were familiar with edamame prior to purchasing the container and 78.8% had purchased edamame before at supermarkets, natural food stores, farmers markets, or restaurants. They had purchased edamame frozen, fresh, shelled, and inshell. Each participant had purchased soy or soy based products prior to

purchasing the container of edamame and indicated that they regularly consumed Chinese, Japanese, and/or Korean foods. All survey participants indicated that they had a 2003 household income of greater than $40,000 and 84.4% indicated that the category white/Anglo best described their ethnicity. The majority (93.8%) of respondents were the primary food shoppers in their household and 15.6% indicated that they were vegetarian or vegan. Seventy-nine percent of respondents indicated that they served the edamame as an appetizer or side dish and only one of the respondents prepared the sample recipe that was attached to the bottom of the container.

Participants also responded to questions regarding demographic characteristics including gender, age, education level, and number of people in the household (Table 4). Results indicate that 51.6% of respondents were more likely to purchase the edamame because it was grown in Pa. and 84.4% were more likely to purchase it because it was grown without the use of pesticides. In addition, 56.2% of respondents indicated that they currently purchase vegetables based on claims that eating the vegetable may decrease their risk of cancer and/or other diseases and 83.9% would be willing to purchase a new vegetable if similar evidence was available. In the future, respondents would prefer to purchase edamame inshell (48.5%) or both inshell and shelled (48.5%).

Table 4. Demographic information and responses to behavioral questions asked on a survey attached to the edamame clamshell purchased at four supermarkets in metro-Philadelphia between 1 Sept. and 13 Oct. 2004.

	No. of responses (n=31-33)	Valid percent
Gender		
Male	4	12.5
Female	28	87.5
Age		
$\leq$ 47	21	65.6
$\geq$ 48	11	34.4
Education level		
Some high school	0	0.0
High school graduate	1	3.1
Some college	3	9.3
Associate degree or technical school graduate	2	6.3
Bachelor's degree	11	34.4
Professional degree	2	9.3
Master's degree	6	18.8
Doctorate degree	6	18.8
Household members $\geq$ 18		
1 per household	4	12.9
$\geq$ 2 per household	27	87.1
Household members < 18		
0 per household	18	58.1
$\geq$ 1 per household	13	41.9
Purchased edamame before		
Yes	26	81.2
No	6	18.8
More likely to have purchased the edamame because it was grown in Pa.		
Yes	16	51.6
No	15	48.4
More likely to have purchased the edamame because it was grown pesticide free		
Yes	27	84.4
No	5	15.6
Specifically purchase vegetables based on claims that eating the vegetable may decrease their risk of cancer and/or other diseases		
Yes	18	56.2
No	14	43.8

Would be willing to purchase a vegetable they had never eaten before if there was evidence that eating it may decrease their risk of cancer and/or other diseases		
Yes	26	83.9
No	5	16.1
In the future would prefer to buy edamame as		
Inshell only	16	48.5
Shelled only	1	3.0
Both inshell and shelled	16	48.5

Respondents were also asked to rate on a scale of 1 to 7 (1 being very unlikely and 7 being very likely), how likely select factors affect their decision when purchasing a new produce item: packaging, price, sample of the product at a supermarket, recipe card or recipe on package, in-store signage, television advertisements, friend's recommendation, health benefits stated on the package, a magazine or news article, an informative brochure, store circular, and in-store cooking demonstrations. The mean rating and standard deviation of each factor are presented in Table 5 as a representation of the distribution of responses. In all instances, the standard deviation was less than two points on the 7-point scale. Select factors were distinguished as in-store promotions, outside advertising, and product packaging. A friend's recommendation received the highest rating among the factors participants had to choose from. For in-store promotions, sample of an item at a supermarket rated highest among factors affecting participants' decisions to purchase a new produce item. When examining outside advertising, television advertisements rated lowest among factors in influencing purchasing decisions. In addition, health benefits stated on the package rated highest as affecting the decision to purchase a new produce item when considering product packaging.

Table 5. Mean likeliness of factors affecting in-store survey participants' decisions to purchase new produce items from supermarkets (n = 30-32).

Factors	Mean[z] ± SD[y]
Friend's recommendation	5.55 ± 1.48
Price	4.97 ± 1.82
In-store promotions	
Sample of produce at supermarket	4.97 ± 1.88
In-store cooking demonstration	4.44 ± 1.78
In-store signage	4.23 ± 1.71
Store circular	3.55 ± 1.61
Outside advertising	
Magazine or news article	4.78 ± 1.72
Informative brochure	4.41 ± 1.76
Television advertisement	2.55 ± 1.41
Product packaging	
Health benefits stated on package	4.74 ± 1.84
Overall packaging	3.91 ± 1.86
Recipe card or recipe on package	3.44 ± 1.70

[z] Scale: 1 to 7, 1 being very unlikely and 7 being very likely
[y] SD = Standard deviation

To more effectively determine packaging and promotional materials that best attract the attention of potential buyers, open-ended questions addressing the packaging and product visibility were asked. Written comments suggested that buyers liked the clear packaging, the recyclable container, and portion size, but felt simple preparation instructions would have been more beneficial than a recipe. Recommendations for improving the packaging included using a larger label, adding more information to the label including nutritional value, using a more colorful label or a four-color insert and increasing the prominence of Pennsylvania grown. One participant commented, "I hope to continue to see these beans for sale! We love them!"

Consumer Acceptance of Edamame-based Patties (As presented in Montri et al., in manuscript)

Of the 209 participants involved in the two-day consumer sensory evaluation, 82.1% and 82.5% were female on the first and second day, respectively. Each day, approximately 3% of

participants responded that they were either vegetarian or vegan and at least 86% considered themselves the primary shopper for their household. On both days, representation for education level was obtained for all categories (some high school, high school graduate, some college, associate degree or technical school graduate, bachelor's degree, professional degree, master's degree, or doctorate degree) except "some high school." On the first day, annual household income ranged from less than $20,000 to greater than $160,000. On the second day, annual household income ranged from less than $20,000 to up to $119,999. Each day, more than 84% of participants were of white/Anglo ethnicity and more than 70% had no one under the age of 18 living in their household.

Consumer evaluation of the sample overall and flavor indicated that the majority of participants liked both patties (Table 6). Overall mean liking for the patties was 6.38 for the edamame, button mushroom, and walnut patty and 6.58 for the edamame and Portobello patty while mean liking for flavor was 6.44 and 6.83, respectively. Forty-nine percent of participants liked the appearance of the edamame, button mushroom and walnut patty and 43.8% of participants liked the appearance of the edamame and Portobello patty. On the first day 23.6% of participants rated the texture of the edamame, button mushroom, and walnut patty as "just about right" while 70.7% felt it was too soft. On the second day, 11.7% of participants rated the texture of the edamame and Portobello patty as "just about right" while 87.4% felt it was too soft. Verbal comments from some participants following both days of evaluations included interest in purchasing these edamame-based patties and interest in obtaining the recipe so they could prepare these patties at home.

Table 6. Percentage of consumers that participated in a consumer sensory evaluation on 9-10 Feb. 2005 who liked the sample overall, appearance, and flavor of the edamame-based patties and the mean score each sensory aspect received. Patties were sampled independently to avoid comparisons between the two.

	Edamame, button mushroom and walnut patty sampled on 9 Feb. 2005		Edamame and Portobello patty sampled on 10 Feb. 2005	
	Mean score[y]	% Liked[z]	Mean score	% Liked
Overall sample	6.38	78.4	6.58	82.6
Appearance	5.42	49.0	5.15	43.8
Flavor	6.44	75.5	6.83	89.3

[y] Scale: 1 to 9, 1 being dislike extremely and 9 being like extremely
[z] Combined responses for like: extremely, very much, moderately and slightly

Based on the sample, 43.4% and 35.9% of participants, for day one and day two, respectively, indicated that they "probably would buy" or "definitely would buy" this item from a supermarket. Answers for consumer marketing questions were merged for the two-day period. Seventy-five percent of participants were not familiar with edamame prior to this study and an additional 4.8% were unsure if they were familiar with edamame leaving 20.2% of participants indicating they were familiar with edamame. This percentage is much lower than the 100.0% of consumers who responded to the survey attached to the clamshell container of edamame sold during the supermarket study who indicated that they were familiar with edamame prior to purchasing. Although the percentage of participants familiar with edamame was low, 77.1% of participants had purchased soy or soy-based products prior to the consumer sensory evaluation including sauces, such as soy sauce; soy-based cheeses; soy protein items, such as tofu; baked goods made from soy flour; soy milk or soy-based beverages; soy-based yogurt or ice cream; meat substitutes, such as soy hot dogs or veggie burgers; and soy nuts or other soy-based snacks. Approximately 42% of participants indicated that they currently purchase meat substitutes such as soy hot dogs or veggie burgers.

Responses were segmented based on demographic characteristics including gender, age, education level, and number of people in the household to determine if one particular group from the criterion-based sample generated more positive responses to certain behavioral questions than their counterpart and were therefore more likely to become a potential buyer (Kelley and Sánchez, 2005; Table 7).

Table 7. Effect of gender, age, education level, number of people in household ≥ 18 years of age, number of people in household < 18 years of age, household income, and vegetarianism on participants' answers to questions asked during a sensory evaluation on 9 and 10 Feb. 2005. Responses to consumer research questions were combined for the two-day evaluation period (n=124).

Survey question	Gender		Age		Household members				College graduate		2004 Household income[x]		Vegetarian[y]	
					≥ 18 years		< 18 years							
	Male	Female	≤ 40	≥ 41	1	≥ 2	0	≥ 1	Yes	No	≤ $39,999	≥ $40,000	Yes	No
No. of participants per segment	23	101	81	43	21	103	90	34	63	61	45	62	4	116
% of participants per segment	19	81	65	35	17	83	73	27	51	49	36	50	3	94
How often are vegetables purchased based on nutritional content?														
Always (%)	13	27*	20	33[NS]	19	25[NS]	21	32*	25	23[NS]	20	21[NS]	0	25*
Often (%)	43	54	58	42	57	51	49	62	56	49	56	60	25	53
Sometimes (%)	22	13	10	23	5	17	19	3	10	20	13	15	75	13
Rarely (%)	17	6	11	2	14	7	10	3	8	8	9	5	0	8
Never (%)	4[z]	0	1	0	5	0	1	0	2	0	2	0	0	1
How often are vegetables purchased based on claims that eating them may decrease their risk of cancer and/or other diseases?														
Always (%)	13	15[NS]	6	21[NS]	14	15*	12	21*	13	16[NS]	13	13[NS]	0	16*
Often (%)	35	50	9	51	29	51	42	62	44	51	44	55	0	48
Sometimes (%)	26	25	28	19	24	25	30	12	25	25	27	23	50	24
Rarely (%)	13	6	46	5	24	4	8	6	8	7	7	5	0	8
Never (%)	13	4	11	5	10	5	8	0	10	2	9	5	50	4

Survey question	Gender		Age		Household members				College graduate		2004 Household income		Vegetarian	
					≥ 18 years		< 18 years							
	Male	Female	< 40	≥ 41	1	≥ 2	0	≥ 1	Yes	No	≤ $39,999	≥ $40,000	Yes	No
How often are soy-based products purchased?														
More than once a week (%)	4	7 [NS]	10	0 [NS]	10	6 [NS]	6	9 [NS]	10	3*	7	3 [NS]	0	7 [NS]
Once a week (%)	26	8	9	16	5	13	9	18	16	7	11	15	0	12
2-3 times a month (%)	9	11	7	16	14	10	11	9	13	8	4	11	0	10
Once a month (%)	26	24	22	28	14	26	28	25	27	21	27	23	25	24
A few times a year (%)	13	40	40	26	52	31	32	41	29	41	38	35	75	34
Never (%)	22	11	12	14	5	15	14	9	6	20	13	13	0	13
How many dinners, on average, are prepared at home each week (1 wk = 7 d)?														
Five or more (%)	43	66*	54	77*	67	61 [NS]	63	59 [NS]	73	51*	58	66 [NS]	50	62 [NS]
Four (%)	13	12	14	9	0	15	9	21	9	15	11	16	0	12
Three (%)	30	11	17	9	19	14	14	15	13	16	22	11	0	16
Two (%)	13	7	11	2	10	8	11	0	5	11	9	5	50	7
One (%)	0	1	0	2	0	1	1	0	0	18	0	0	0	1
None (%)	0	3	4	0	5	2	1	6	0	5	0	2	0	3
On average, how much time is spent preparing for dinner?														
Less than 15 minutes (%)	43	11*	23	7 [NS]	20	17 [NS]	20	9 [NS]	16	19 [NS]	22	16 [NS]	75	14*
15 to 30 minutes (%)	43	55	49	60	55	52	51	56	60	44	58	51	0	57
30 minutes to 1 hour (%)	13	34	28	33	25	31	28	34	24	36	20	33	25	29
More than 1 hour (%)	0	0	0	0	0	0	0	0	0	0	0	0	0	0

[NS] Nonsignificant, * significantly different between columns (e.g., male and female) within a demographic variable (e.g., gender) per survey question at $p \leq 0.05$ based on Mann Whitney U.

[x] 17 participants preferred not to indicate their 2004 annual household income.

[y] Four participants indicated that they were unsure if they were a vegetarian or a vegan.

[z] Columns may be greater than, equal to, or less than 100 due to rounding.

Females purchased vegetables more often based on nutritional content than males with 81% of females indicating that they "always" or "often" purchase vegetables based on nutritional content as opposed to 56% of males. Differences were also seen based on the number of children (< 18 years in age) per household with 94% of households containing at least one child indicating that they "always" or "often" purchase based on nutritional content compared to 70% of households with no children.

Households consisting of one adult indicated they "always" or "often" purchase vegetables based on claims that eating them may decrease their risk of cancer and/or other diseases 43% of the time as opposed to 66% of households containing more than two adults. Households with no children indicated they "always" or "often" purchase vegetables based on these claims 54% of the time compared to 83% of households composed of more than one child.

Participants who were not college graduates purchased soy-based products fewer times and prepared fewer meals at home. Thirty-nine percent of college graduates purchase soy-based products two to three times a month or more as opposed to 18% of those who have not graduated from college. In addition, 95% of college graduates prepare three or more dinners a week, on average, compared to 82% of non-college graduates.

Females prepared more dinners at home each week than males with 66% of females preparing five or more dinners at home each week. Eighty-six percent of males spend less than 30 min, on average, preparing for dinner while 66% of females spend less than 30 min and 34% spend between 30 min and one hour preparing for dinner. Participants older than 41 years of age also were more likely to prepare dinners at home compared to participants 40 years of age and younger with 77% of participants older than 41 preparing five or more dinners each week.

Three percent of participants were vegetarian or vegan. This percentage is similar to vegetarianism in the United States, in which 2.8% of the population is vegetarian (Vegetarian Resource Group, 2003). Twenty-five percent of vegetarians indicated that they "always" or "often" purchase vegetables based on nutritional content as opposed to 78% of non-vegetarians and 0% of vegetarians indicated that they "always" or "often" purchase vegetables based on claims that eating them may decrease their risk of cancer and/or other diseases compared to 64% of non-vegetarians who do. Seventy-five percent of the vegetarian participants indicated they spend less than 15 min preparing for dinner, on average. Fourteen percent of non-vegetarians indicated the same.

Participants also ranked select product characteristics which influence their decision to purchase new food items by importance. Criteria were ranked in the same order on both days (Table 8). On the first day, flavor, nutritional value, and price were ranked as the three most important criteria that influence purchasing decisions with no statistical difference between the three. On the second day, the criteria ranked as the most influential when purchasing a food item were flavor, nutritional value, price, and quality with no statistical difference observed between these four criteria. The least preferred criteria on both days were new food item, packaging, and vegetarian item.

Table 8. Criteria which affect decisions of consumer sensory evaluation participants to purchase a food item ranked in order of importance. Rank total based on sum of ranks (1=most preferred, 10=least preferred).

Criteria	Edamame, button mushroom and walnut patty sampled on 9 Feb. 2005		Edamame and Portobello patty sampled on 10 Feb. 2005	
	Overall rank	Rank total[z]	Overall rank	Rank total
Flavor	1	276 $_{a}$	1	274 $_{a}$
Nutritional value	2	337 $_{ab}$	2	323 $_{a}$
Price	3	408 $_{abc}$	3	381 $_{a}$
Quality	4	422 $_{bc}$	4	410 $_{ab}$
Appearance	5	517 $_{cd}$	5	522 $_{bc}$
Convenience	6	580 $_{de}$	6	550 $_{cd}$
Advertising	7	668 $_{e}$	7	674 $_{de}$
New food item	8	836 $_{f}$	8	788 $_{ef}$
Packaging	9	860 $_{f}$	9	829 $_{f}$
Vegetarian item	10	926 $_{f}$	10	914 $_{f}$

[z] Rank totals followed by the same letter are not significantly different using Friedman's Analysis of Rank and Tukey's HSD procedure ($\alpha = 0.05$).

Overall Project Conclusions:

The introduction of edamame into the consumer's diet has the potential to be a successful venture. Over half of the participants in the 2002 survey groups (92% sensory evaluation and 66% of telephone survey participants) would likely eat edamame after being informed about the potential health benefits, origin, preparation and uses. It is possible that the significant difference between the two groups occurred because sensory evaluation participants not only read about edamame's characteristics, but also had an opportunity to view a photograph of edamame beans prior to tasting. Therefore, it may be beneficial to include both pieces, written and visual descriptions, on packages for sale in retail outlets. Clearly, a majority of participants in both surveys found some value when reading about edamame characteristics and if a more desirable cultivar is used, such as 'Kenko'; an attractive retail combination could be created.

In addition, results indicate there is a demand for Pennsylvania-grown edamame among Metro-Philadelphia chefs who participated in this study. When asked how likely they were to use edamame as an ingredient in a recipe again, over half of the chefs were "very likely" to use edamame again and none of the chefs chose the "unlikely" rating. Fourteen of the 18 chefs were also interested in obtaining edamame from a Pennsylvania grower for use in their restaurant. This indicates that small-acreage growers in Pennsylvania may become potential suppliers.

Two additional marketing options include fresh, inshell edamame for retail sales in supermarkets and edamame-based patties as an addition to a prepared foods department in supermarkets. Based on conversations with regional produce managers and produce department managers, select supermarkets are willing to work with small-acreage growers interested in producing edamame for fresh market. There may be consumer demand for fresh, inshell edamame in the produce sections of select supermarkets, especially those in areas with demographics similar to those in the present study. Beans from pods that do not meet pod quality standards could be used for processing by prepared food departments in supermarkets. A promotional campaign focusing on consumer awareness of edamame and the health benefits associated with eating edamame could be a vital step to introducing these two products for market.

Suggestions for Further Research

Future research could focus on investigating true demand for edamame-based burgers sold in supermarkets and other retail outlets. Additional sensory evaluations could also test consumer acceptance of additional value-added products.

Further research on production in Pennsylvania may also be necessary. Currently, limited commercially available cultivars with suitable seedling emergence and plant populations present a major constraint to commercial edamame production.

Benefits Derived From the Project

This research not only assessed demand for edamame and value-added edamame products but also investigated potential markets for these goods, including supermarkets and restaurants. In addition, the researchers also determined what criteria consumers consider when purchasing a new produce item, such as edamame or an edamame-based product. Focusing on the health benefits associated with eating edamame and providing samples in supermarkets may be two promotional strategies that could possibly increase edamame consumption. Other promotional attributes that may be directly related to production techniques involve the concepts of locally or Pennsylvania-grown and pesticide-free production. Collectively, results indicate that there is a demand for edamame that small-acreage growers could potentially supply. Hence, results are likely to benefit small-acreage growers interested in diversifying their crop product, to include specialty crops such as edamame, for local markets.

However, further research is needed to determine acceptable cultivars for Pennsylvania production. If optimal edamame populations can be established, this product could become a valuable component of a small farm production system.

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